

## CPT Electrical Conductivity Detection of Groundwater Contamination from Deicing Agents

### Application:

Highway Deicing Salts:  
Aquifer Contamination and Cranberry Bogs

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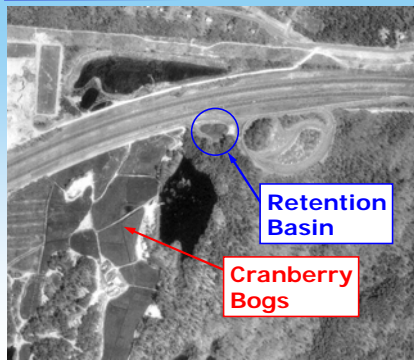
## Test Site: South Eastern Massachusetts



- Storm water runoff from 1.5 km of SR 25 (just outside Cape Cod)
- Calcium Magnesium Acetate (CMA) and NaCl



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→ Groundwater for cranberry irrigation and harvesting

NaCl → plant health

CMA → oxygen depletion

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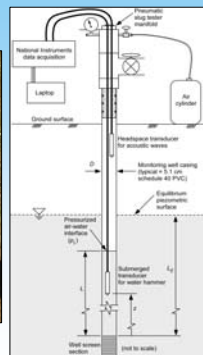
## Aquifer Properties

- unconfined aquifer; 33m to bedrock, ground water table near ground surface
- outwash plain; fine to coarse glacial SAND; at depth SPT N  $\approx$  4/0.3m
- Porosity : 25 to 40%
- $k = 0.1$  cm/s
- horizontal  $i = 0.002$  to  $0.004$  towards ocean
- Ground water flow  $\approx$  10 m/month

→ Good Application for CPT conductivity logging

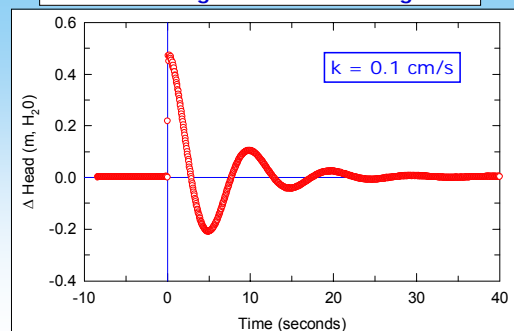
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## Slug Testing



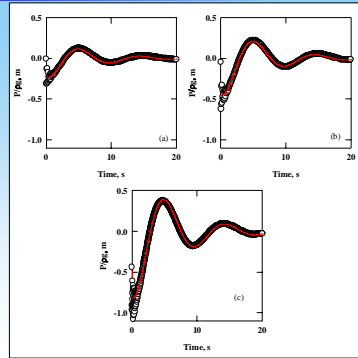
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## Pneumatic Slug Tests – Monitoring Wells



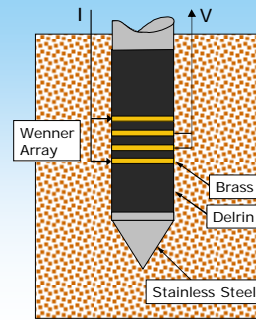
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Fit of model →  
output k value



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### Conductivity Measurement

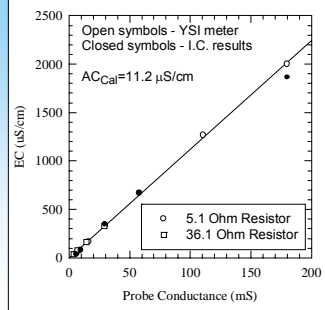


#### Calibration:

- Electrical response of probe → conductance
- Calibrate to electrical conductivity ( $\mu\text{S}/\text{cm}$ ) of soil-pore fluid media
- Calibrate to electrical conductivity of pore fluid → Formation Factor

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### EC Laboratory Calibrations – water solution



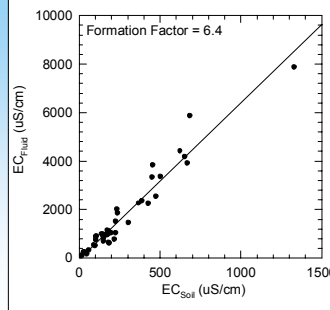
Electrical response of  
probe → conductance

Convert electrical  
signal from cone to  
conductivity =  
 $f(\text{probe geometry:}$   
spacing, diameter,  
size of rings)

Place cone in sodium  
chloride solutions of  
known conductivity

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### EC Laboratory Calibrations – soil/water



Measure electrical  
conductivity of soil-  
pore fluid media with  
separate measurement  
of pore fluid electrical  
conductivity

Calibration slope =  
formation factor  $F \rightarrow$   
influenced primarily by soil  
porosity

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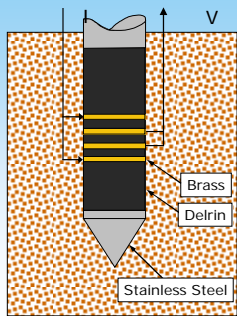


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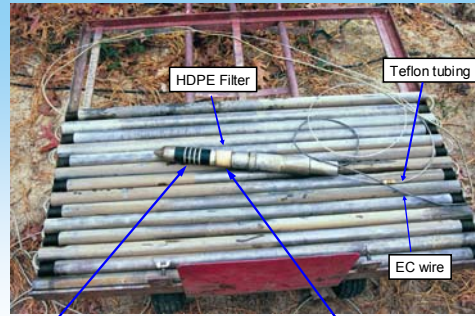
## Conductivity Measurement



### Probe Design:

- 41 mm diameter;
- 2.5 mm electrode thickness
- 3.8 mm electrode spacing.
- Net radius of influence = 27 mm
- Add on collection of water samples → approximate total volume required (purge + sample for Ion chromatography) ≈ 400 ml

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Conductivity

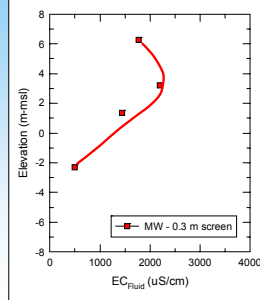
Groundwater Sampling

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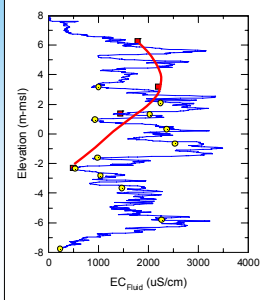


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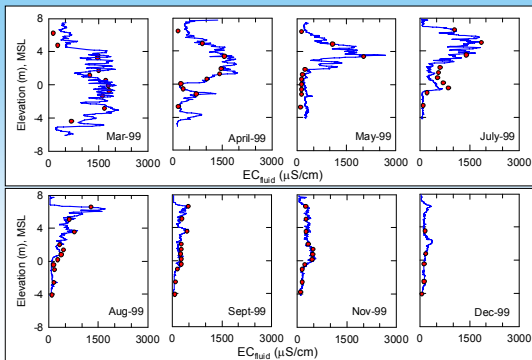
## Monitoring Well Samples



## EC Logging

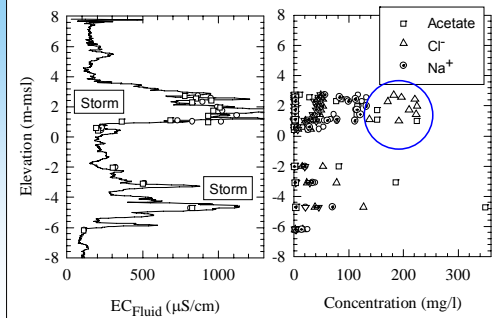


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## Ion Chromatography of EC probe samples



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## Summary

- Spatial distribution → rapid profiling
- Temporal distribution → if have convenient push equipment
- Easy calibration → but no specific ion information
- Sampling module → small volume sampling

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